# Stakeholder Guidance on Coastal Salinity Projects

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# Project 1: FERC-Relicensing

- 6 reservoirs in North Carolina
- Pee Dee River  flows 160 miles to Myrtle Beach
- 3 water intakes along the South Carolina coast
- During drought of 1998-2002, saltwater moved upstream and limited freshwater supply


***Only freshwater portion of the ICW***

# Problem

- North Carolina reservoirs were being re-licensed (50-year permits)
- *Question – How much flows is required to protect freshwater  intakes along South Carolina Coast?*

# Who Cares?

*Study funded by a consortium of stakeholders sitting on opposite sides of  the table*

- Power Companies
- NC and  SC Departments of Natural Resource
- Industries on along the Pee Dee River
- Municipalities in Myrtle Beach

# Flow Dynamics and Salinity Response
# Pee Dee River

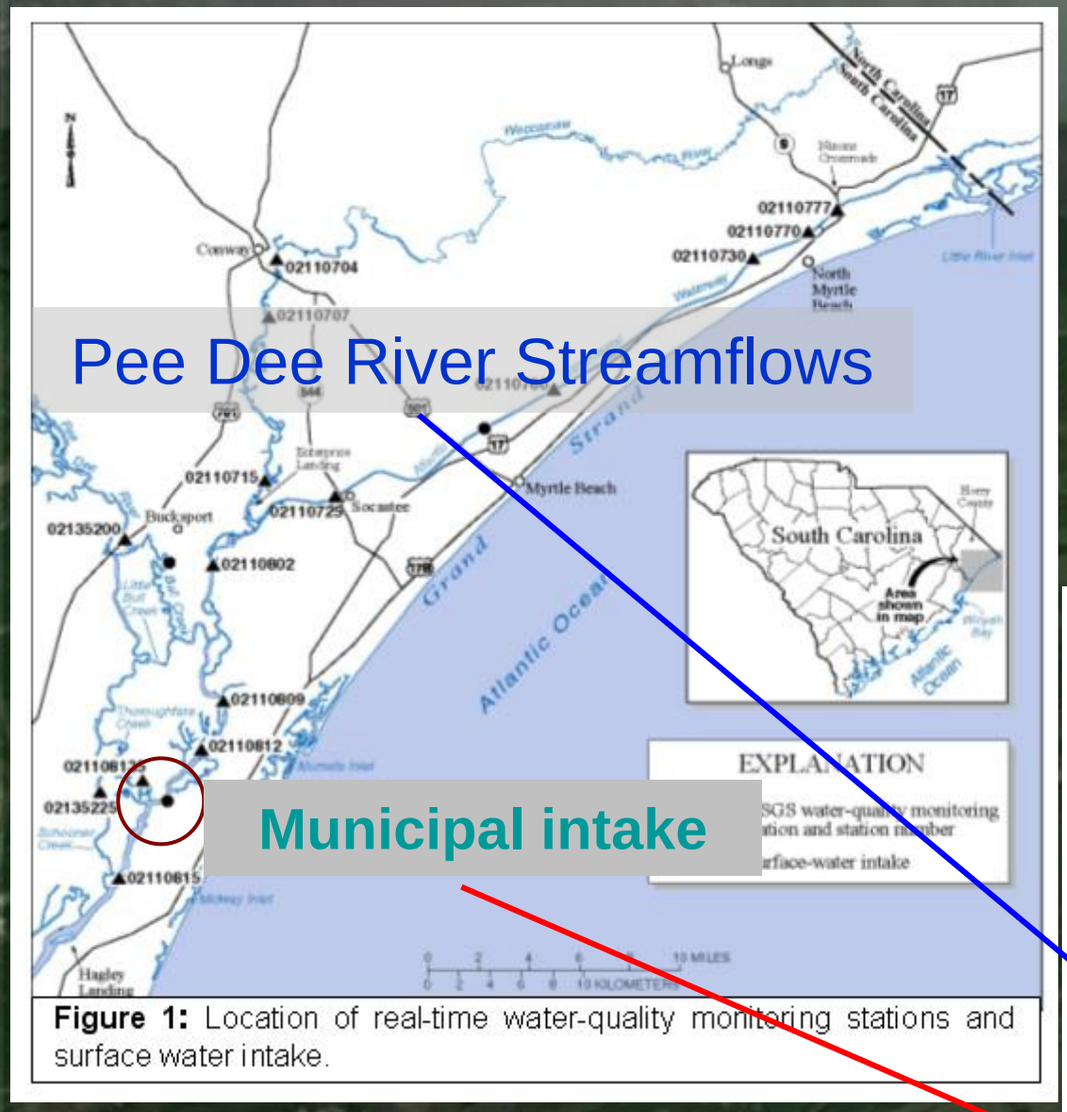
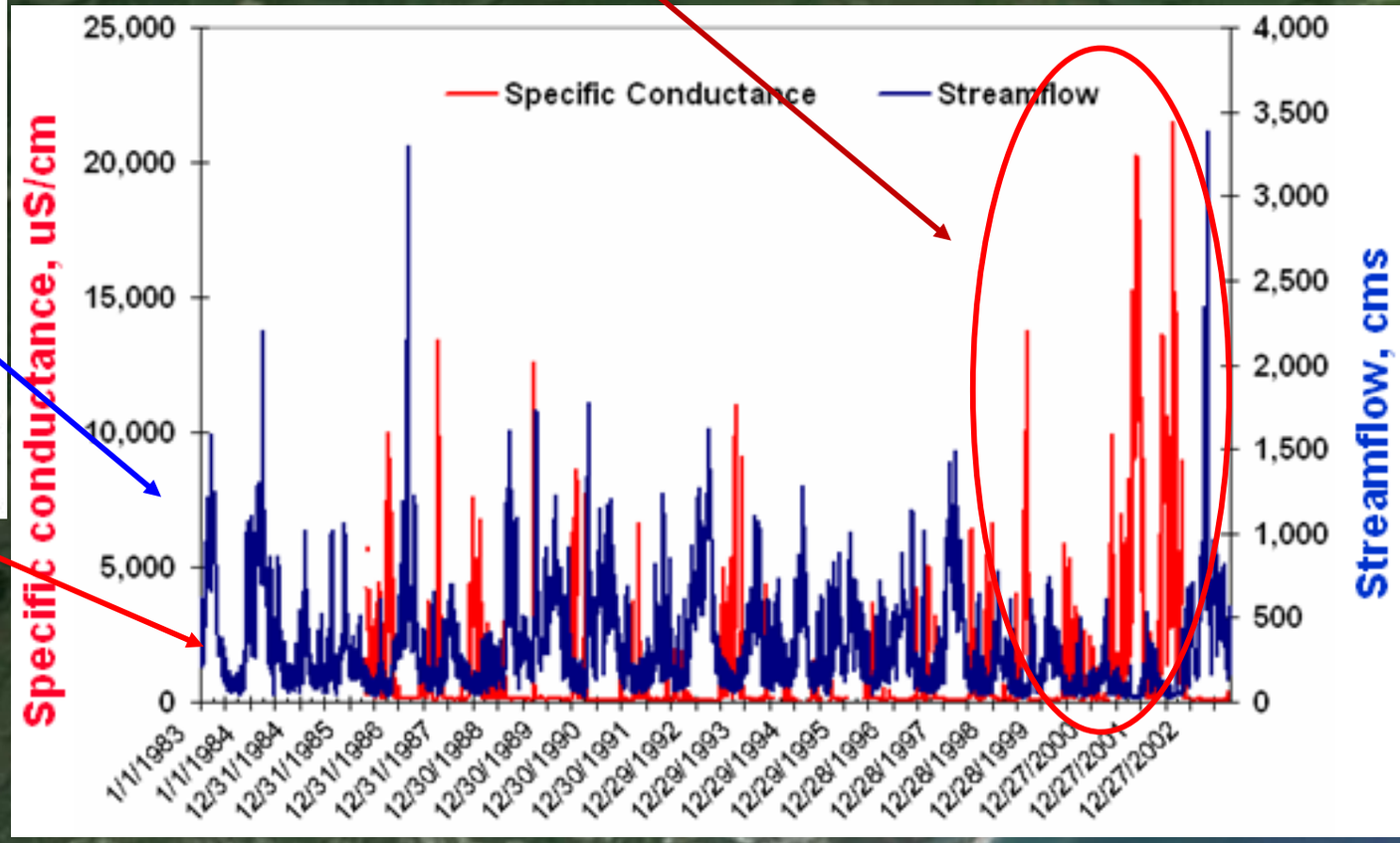



**Figure 1:** Location of real-time water-quality monitoring stations and surface water intake.

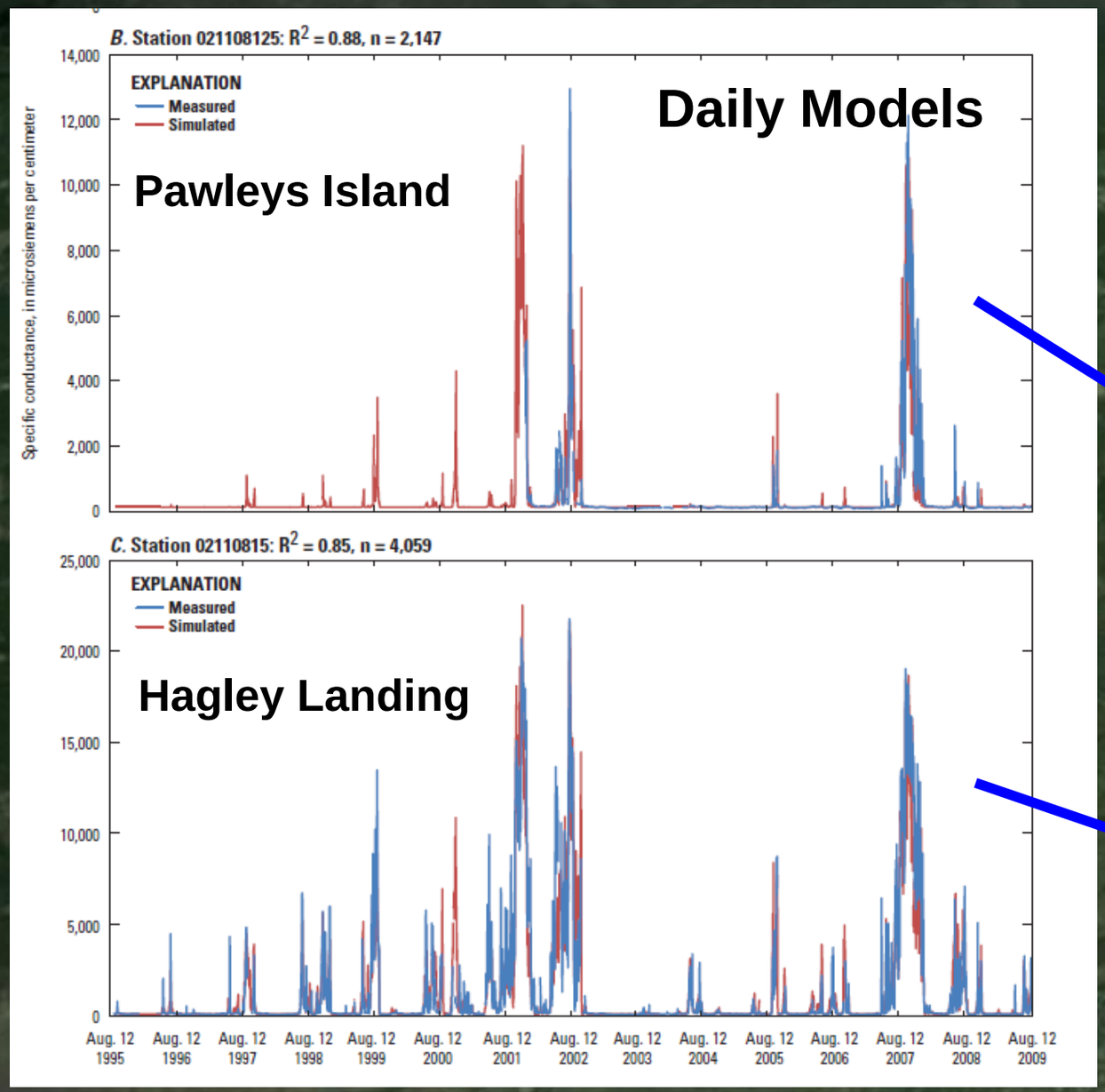
*Drought Period*

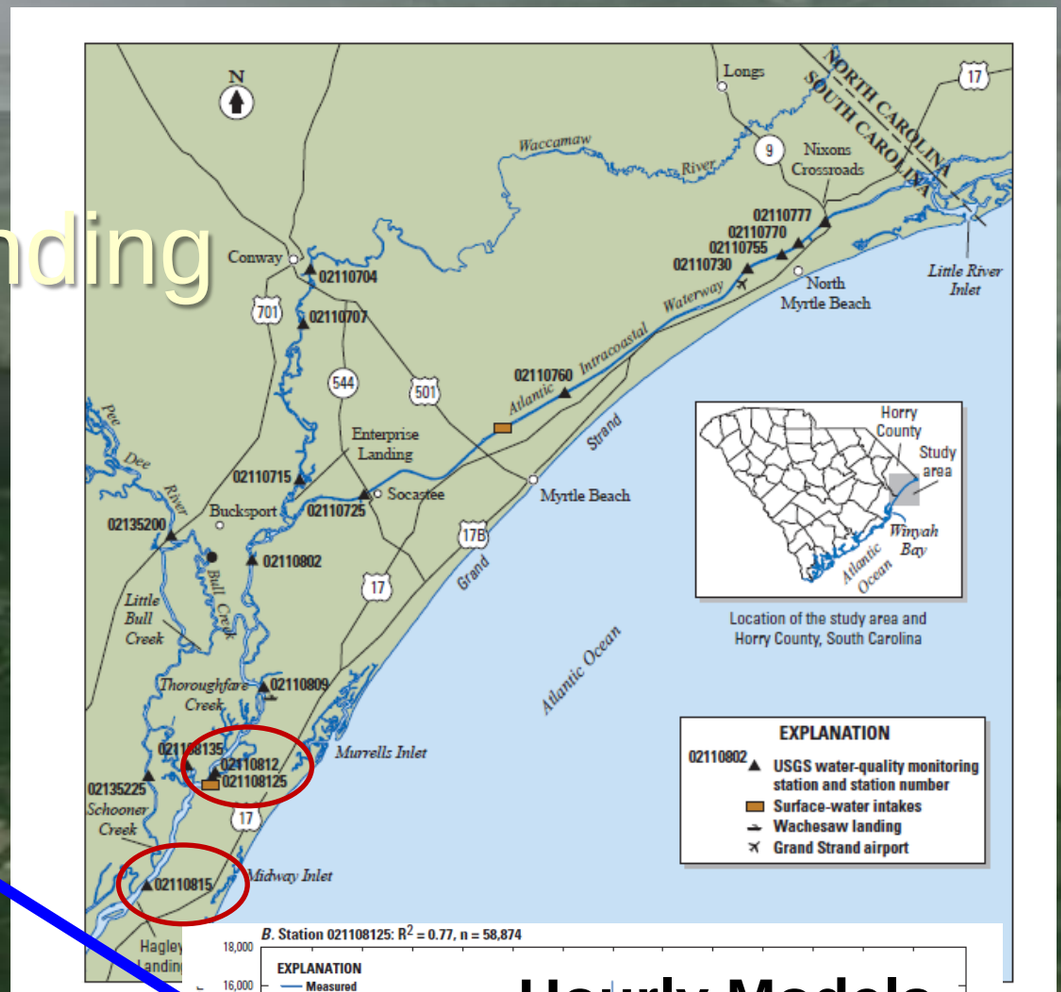


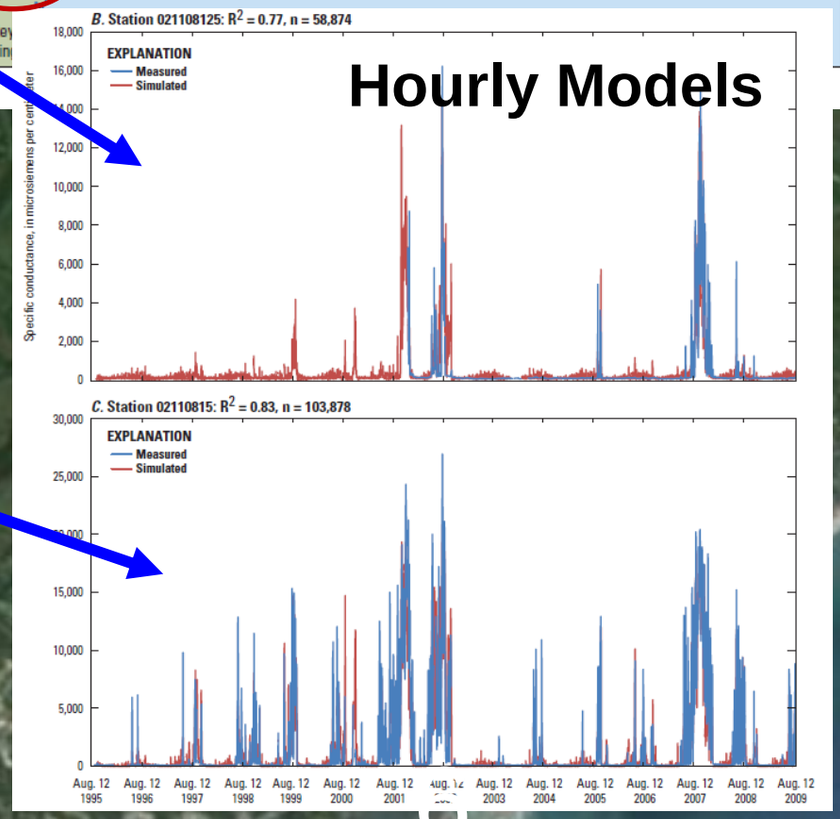

Specific conductance downstream of municipal intake

# Model Performance

## Pawleys Island & Hagley Landing

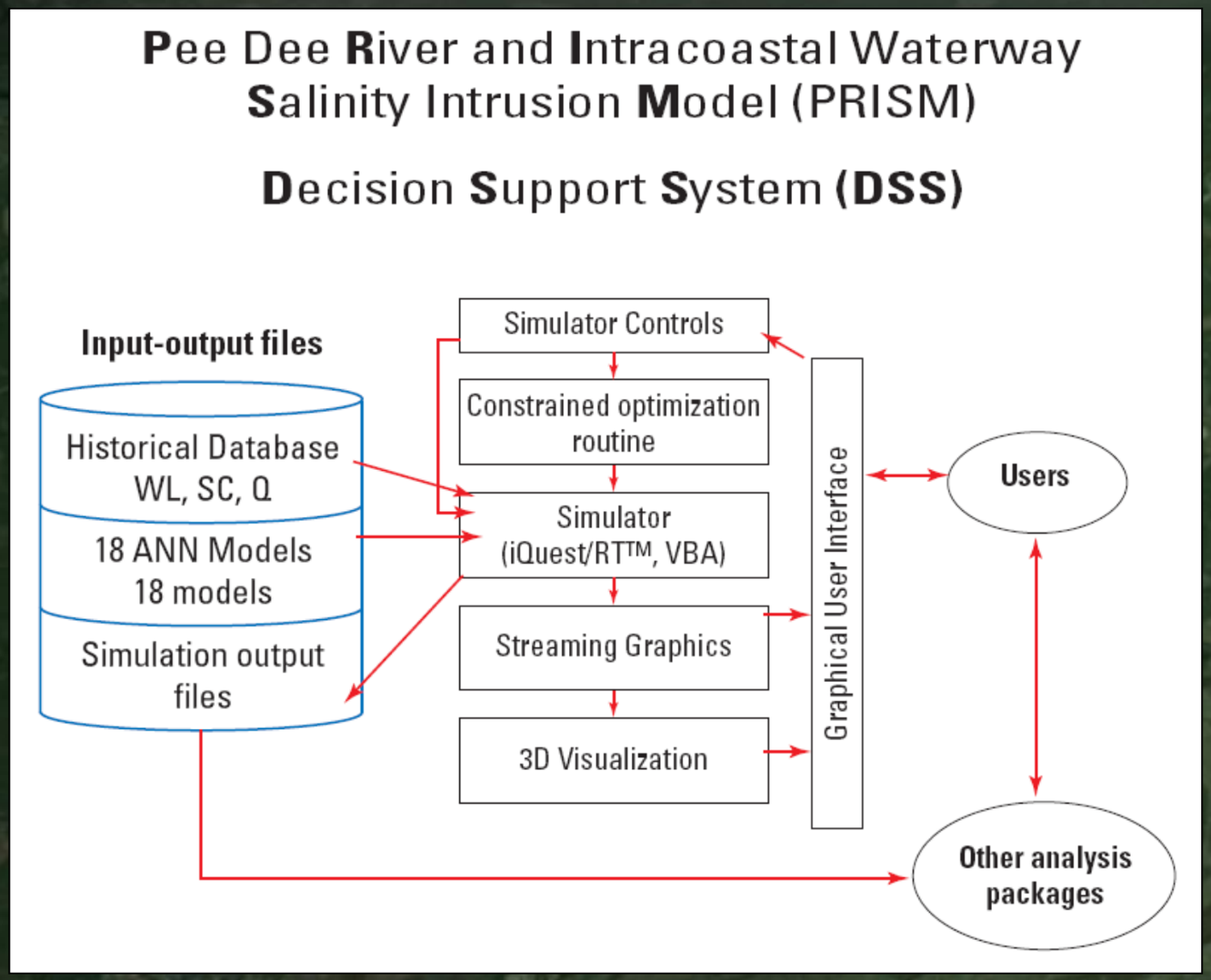


# Decision Support System

## MS Excel Application




- Simulates hourly and daily changes in SC
- User-specified changes in hydrology and sea level:
  - Percent historical
  - Constant
  - User-defined hydrographs

# Model Control

Where Model Files Are Located: C:\PRISM2

**Simulation**

| | |
|---|---|
| Start | 8/12/95 |
| End | 8/21/09 |
| Time Step (hrs) | 24 |
| Sim Time | 8/12/95 0:00 |

**Step / Run**

<< Step | Sim Time=Start | Step >> | RUN | Opt All SC

**Output**

Graphs ON | Write Output | Clear Output

**Abort/Reset**

hold escape key, click End, click RESET | RESET

| | meas. | bias (ft) | user |
|---|---|---|---|
| WL777D | 13.3 | 0.5 | 13.8 |
| WL777H | 13.5 | | 14.0 |

| τ (hr) | QotherDm | QotherDu | Q13100Dm | QtotalDm |
|---|---|---|---|---|
| -0 | 1,769 | 1,946 | 3,550 | 5,634 |
| -24 | 2,005 | 2,205 | 3,864 | 5,230 |
| -48 | 2,296 | 2,525 | 3,225 | 4,887 |
| -72 | 2,649 | 2,914 | 2,591 | 5,920 |
| -96 | 2,975 | 3,272 | 3,270 | 8,305 |
| -120 | 3,280 | 3,608 | 5,330 | 9,151 |
| -144 | 3,570 | 3,927 | 5,870 | 9,385 |

| Gage | Q13100D Input Option | Q13100D Inputs By Option % | cfs | usrHyd | Opt | Q13100Du | QtotalDu | SC SP | SCm | SCp(m) | SCp(u) | dSC(pu-pm) | SCm/p+dSC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 815 D | % | 3,478 | 6,000 | 3,864 | 0 | 3,478 | 5,424 | 4,000 | ? | ? | ? | ? | ? |
| H | | | | | | | | 4,000 | ? | ? | ? | ? | ? |
| 8125 D | % | 3,478 | 6,000 | 3,864 | 0 | 3,478 | 5,424 | 2,000 | ? | ? | ? | ? | ? |
| H | | | | | | | | 2,000 | ? | ? | ? | ? | ? |
| 809 D | % | 3,478 | 6,000 | 3,864 | 0 | 3,478 | 5,424 | 700 | ? | ? | ? | ? | ? |
| H | | | | | | | | 700 | ? | ? | ? | ? | ? |
| 777 D | % | 3,478 | 6,000 | 3,864 | 3,948 | 3,478 | 5,424 | 10,000 | 17,795 | ? | ? | ? | ? |
| H | | | | | | | | 10,000 | 23,800 | ? | ? | ? | ? |
| 770 D | % | 3,478 | 6,000 | 3,864 | 3,601 | 3,478 | 5,424 | 3,500 | 2,298 | ? | ? | ? | ? |
| H | | | | | | | | 3,500 | 6,240 | ? | ? | ? | ? |
| 755 D | % | 3,478 | 6,000 | 3,864 | 15,000 | 3,478 | 5,424 | 1,000 | 250 | ? | ? | ? | ? |
| H | | | | | | | | 1,000 | 232 | ? | ? | ? | ? |
| 760 D | % | 3,478 | 6,000 | 3,864 | 0 | 3,478 | 5,424 | 400 | ? | ? | ? | ? | ? |
| H | | | | | | | | 400 | ? | ? | ? | ? | ? |

| WL Gage | WL Input Option | WL Input Setpoints | |
|---|---|---|---|
| WL777 | bias | ft | 0.5 |

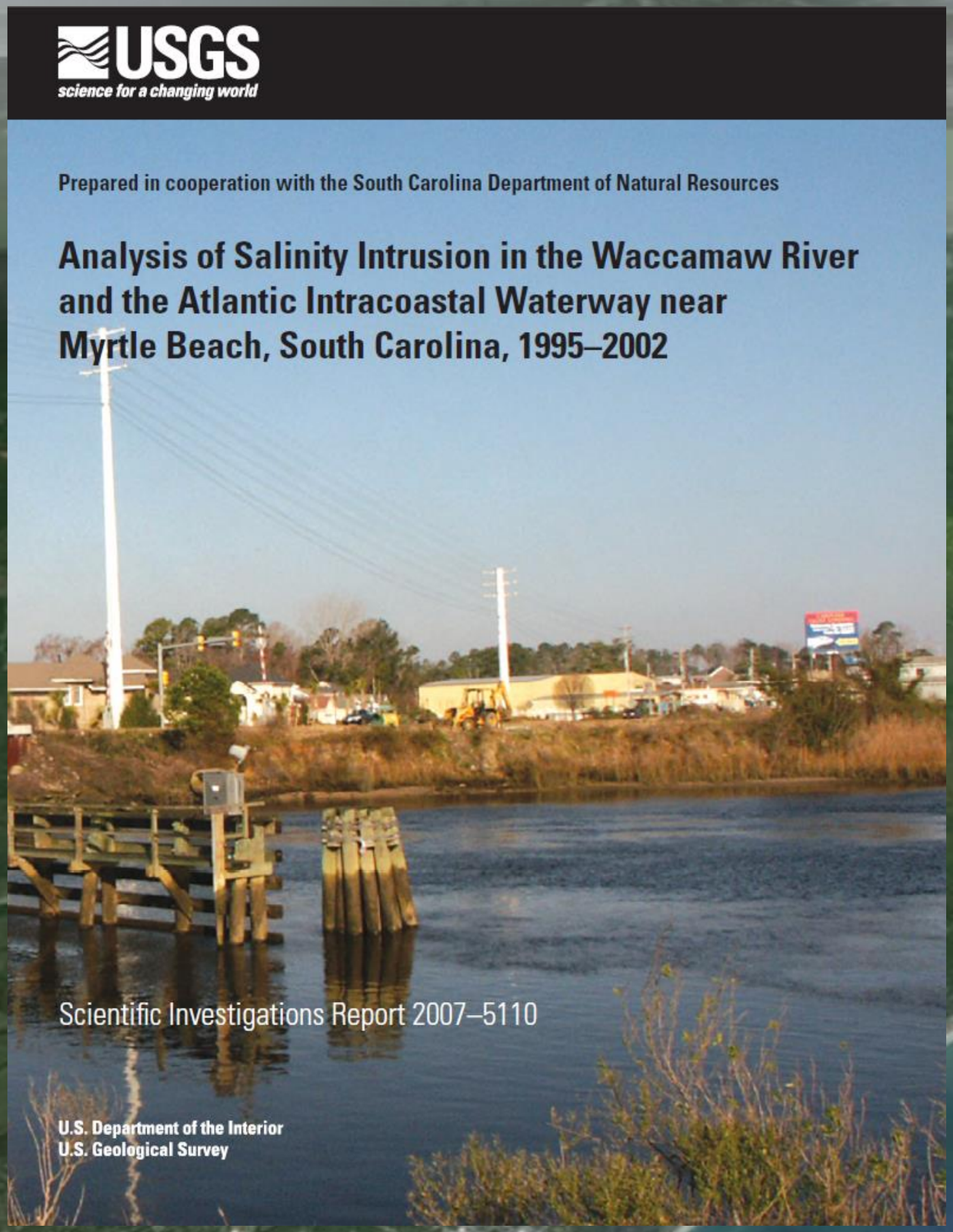
| Q Gage | Qx Input Option | Qx Input Setpoints | |
|---|---|---|---|
| Q10500 | % | % | 110 |
| | % | cfs | 100 |
| Q13200 | % | % | 110 |
| | % | cfs | 200 |
| Q13500 | % | % | 110 |
| | % | cfs | 300 |
| Q13600 | % | % | 110 |
| | % | cfs | 400 |

| SC Gage | Q13100 Input Option | Q13100D Setpoints | | | Historical SC min | Historical SC max | SC Setpoint Limits min | SC Setpoint Limits max | SC Setpoints | |
|---|---|---|---|---|---|---|---|---|---|---|
| 815 | % | 90 | D | | 47 | 21,758 | 500 | 18,000 | 4,000 | |
| | % | 6,000 | H | | 40 | 37,600 | 500 | 33,000 | 4,000 | |
| 8125 | % | 90 | D | | 68 | 12,962 | 500 | 10,000 | 2,000 | |
| | % | 6,000 | H | | 66 | 18,700 | 500 | 16,000 | 2,000 | |
| 809 | % | 90 | D | | 43 | 2,811 | 200 | 2,500 | 700 | |
| | % | 6,000 | H | | 40 | 9,990 | 200 | 8,000 | 700 | |
| 777 | % | 90 | D | | 52 | 36,813 | 500 | 32,000 | 10,000 | |
| | % | 6,000 | H | | 0 | 95,900 | 500 | 45,000 | 10,000 | |
| 770 | % | 90 | D | | 0 | 23,852 | 500 | 20,000 | 3,500 | |
| | % | 6,000 | H | | 0 | 49,300 | 500 | 40,000 | 3,500 | |
| 755 | % | 90 | D | | 46 | 6,835 | 500 | 6,000 | 1,000 | |
| | % | 6,000 | H | | 43 | 18,900 | 500 | 16,500 | 1,000 | |
| 760 | % | 90 | D | | 50 | 510 | 100 | 500 | 400 | |
| | % | 6,000 | H | | 40 | 540 | 100 | 500 | 400 | |

## User Setpoints

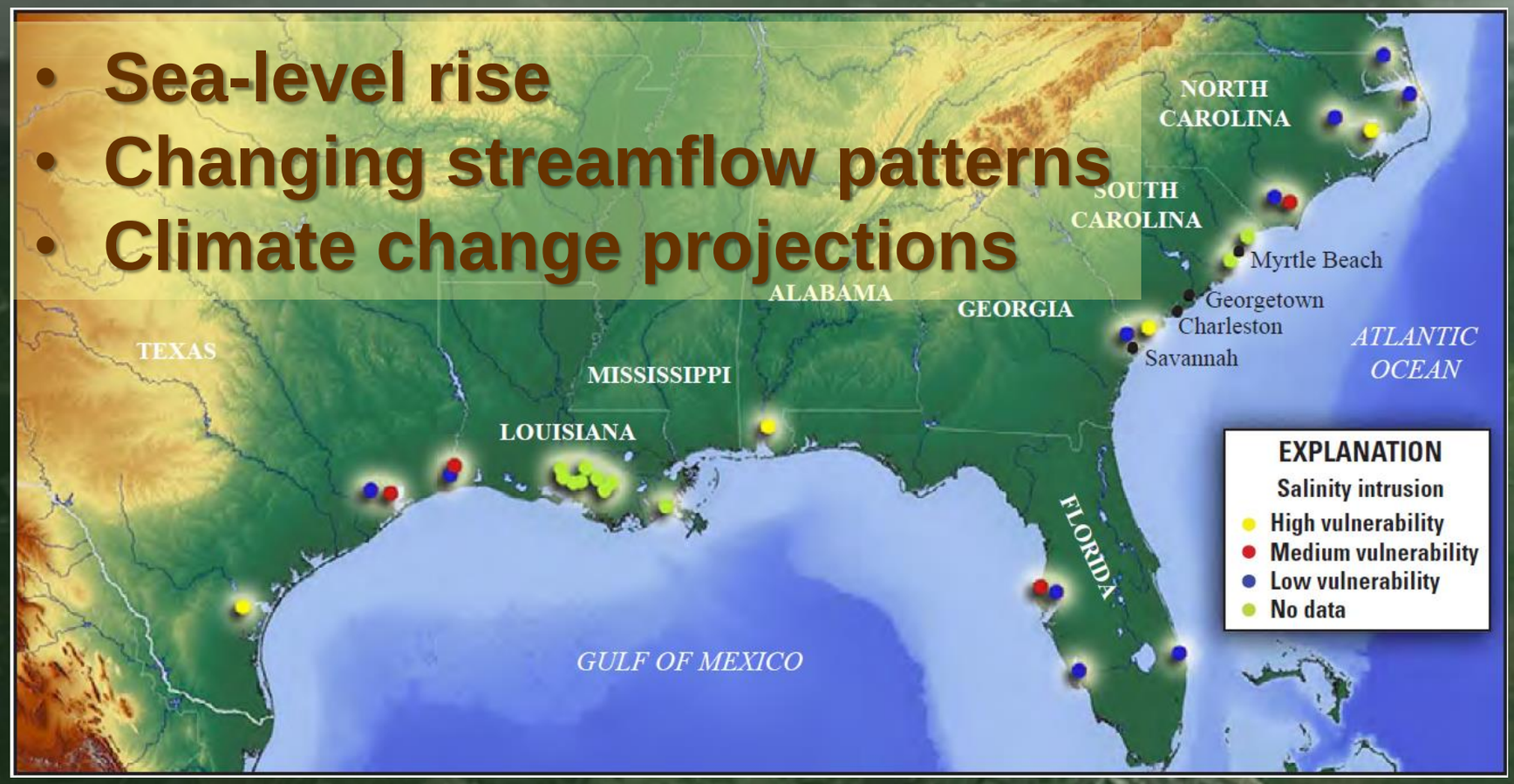
# Major Finding

- Not enough water in North Carolina to project intakes from major salinity intrusion events.



# Project 2: Development of Decision Support Systems for Estimating Salinity Intrusion Effects due to Climate Change on the South Carolina and Georgia Coast

- **Sea-level rise**
- **Changing streamflow patterns**
- **Climate change projections**




## CISA and USGS Collaboration:

Paul Conrads, USGS; Edwin Roehl, ADMi; Daniel Tufford, USC; Greg Carbone, USC; Kirstin Dow, USC; Jessica Whitehead, SC Sea Grant

cisa

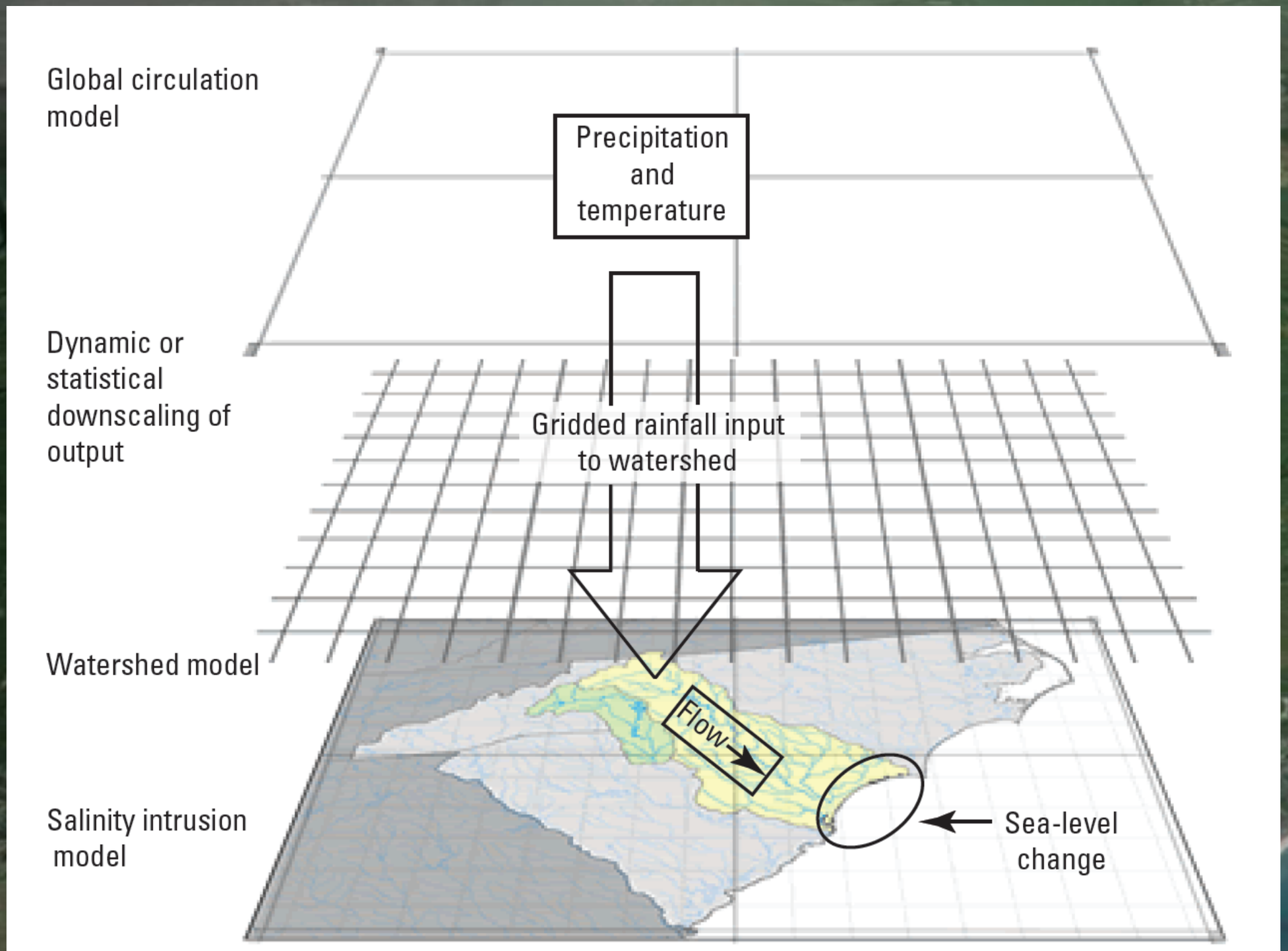
# Issue

- What will be the changes in timing, duration, frequency, and magnitude in salinity intrusion?

- Who Cares?
  - Beaufort-Jasper Water and Sewer Authority
  - Water Research Foundation
  - NOAA Sectoral Application and Research Program (SARP) grant

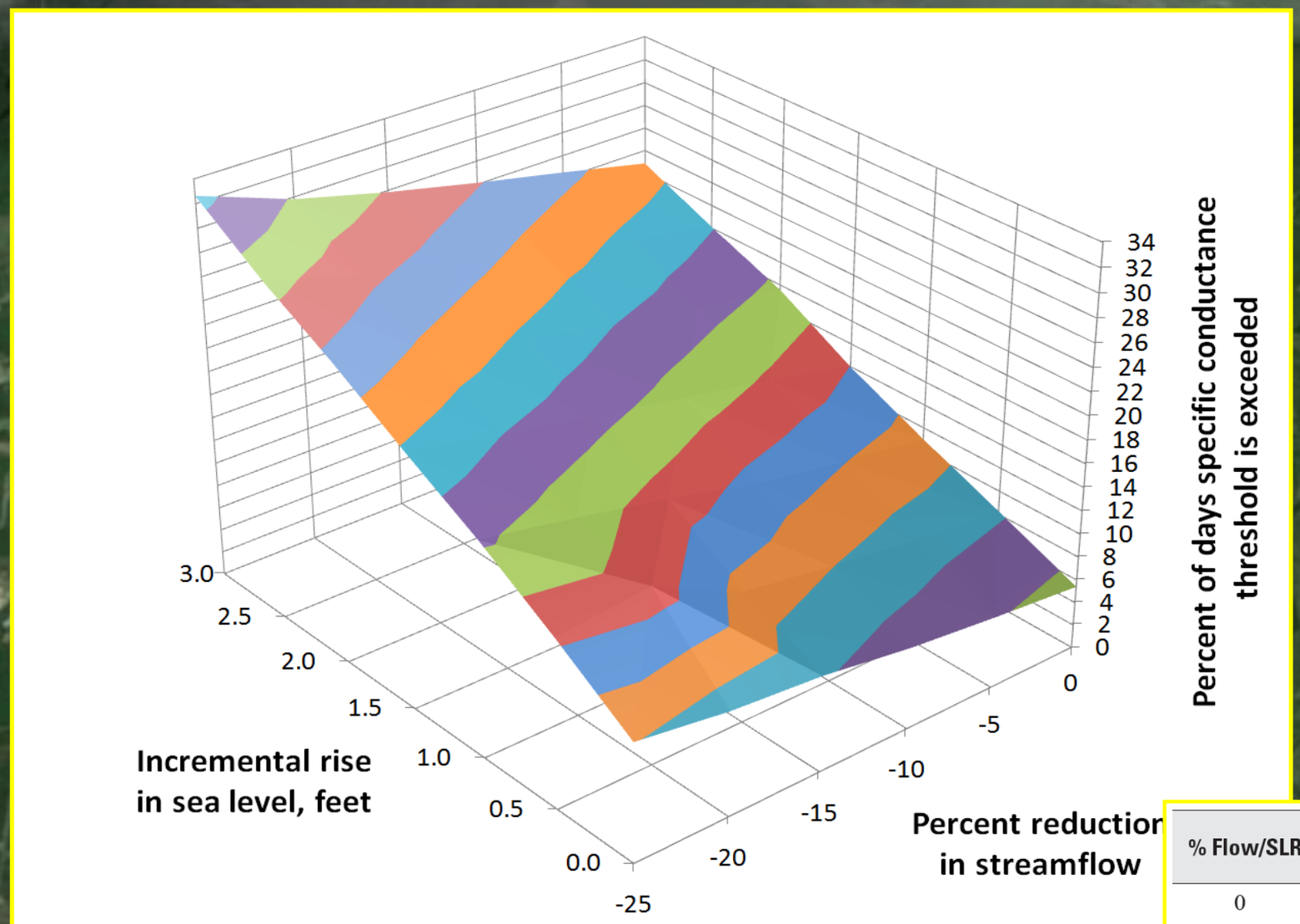
# Integrating Global Circulation Model

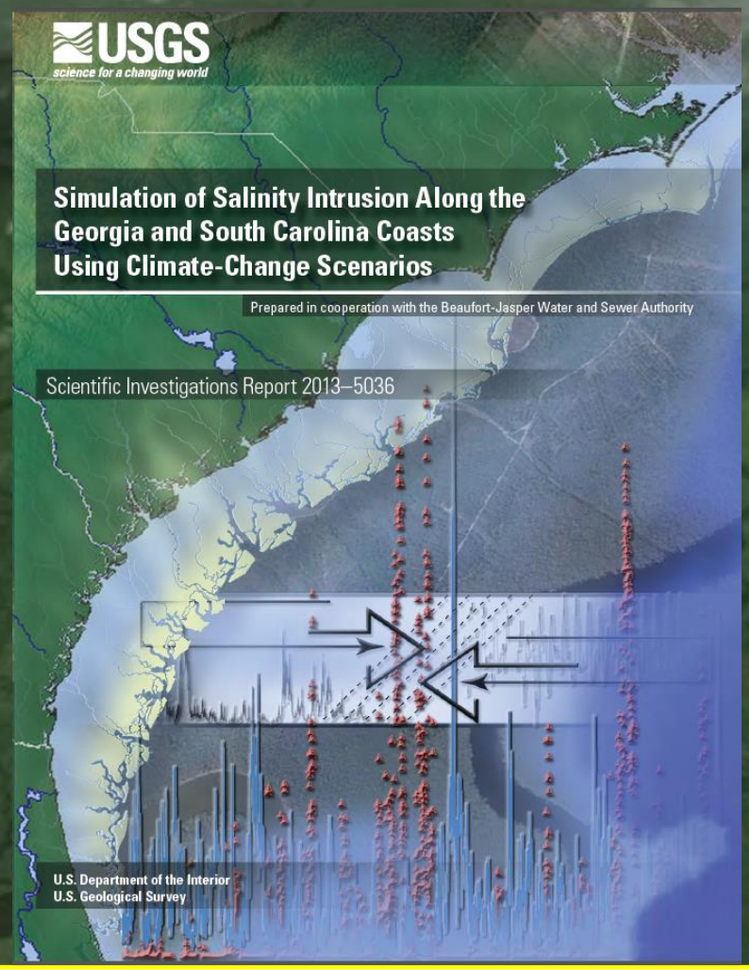
## PRISM 2: Conceptual Model



# 3D Response Surface of Results

## Threshold – 1,000 uS/cm




| % Flow/SLR | Percent of days with specific conductance greater than 1,000 µS/cm[1] | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0 ft | 0.5 ft | 1 ft | 1.5 ft | 2 ft | 2.5 ft | 3 ft |
| 0 | 5.4 | 8.3 | 11.0 | 14.0 | 17.6 | 20.1 | 22.8 |
| –5 | 6.1 | 9.0 | 12.1 | 15.7 | 18.8 | 21.5 | 24.5 |
| –10 | 7.0 | 10.0 | 13.3 | 17.2 | 20.0 | 23.1 | 26.1 |
| –15 | 8.2 | 11.3 | 15.2 | 18.6 | 21.7 | 24.9 | 27.9 |
| –20 | 8.9 | 15.1 | 16.8 | 20.0 | 23.5 | 26.6 | 29.8 |
| –25 | 10.1 | 14.4 | 18.3 | 21.8 | 25.5 | 28.8 | 32.6 |

[1]The model simulation period is June 1994 to July 2008.

# Project 3: Coastal Drought

## The Impact of Drought on Coastal Ecosystems in the Carolinas

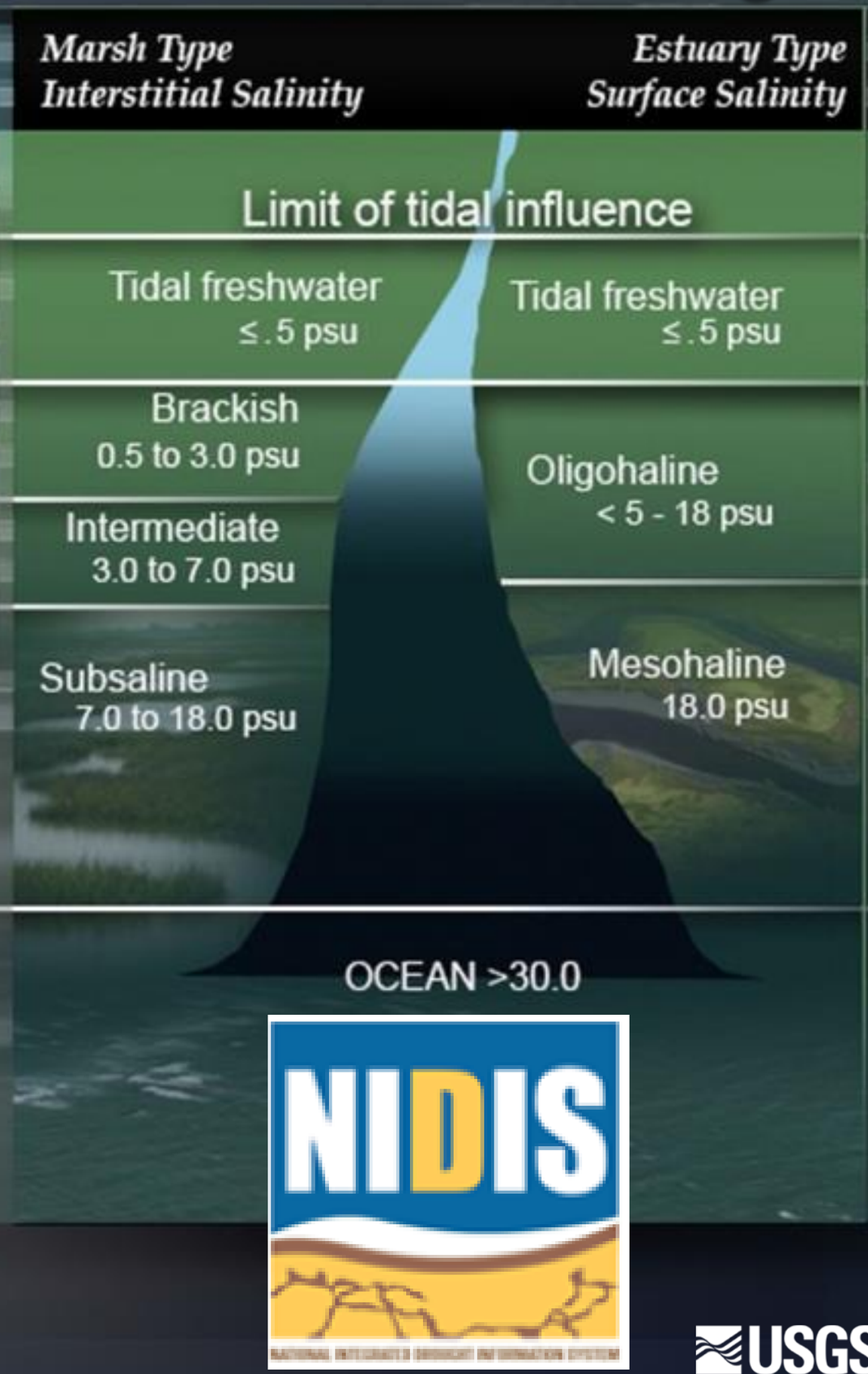
**Executive Summary** January 2012

**Steve Gilbert**, US Fish & Wildlife Service and National Oceanic and Atmospheric Administration (retired)

**Kirsten Lackstrom**, University of South Carolina, Department of Geography, Carolinas Integrated Sciences & Assessments

**Dan Tufford**, Ph.D., University of South Carolina, Department of Biological Sciences, Carolinas Integrated Sciences & Assessments

cisa carolinas integrated sciences & assessments




Question –
Can a drought index be developed for the coast?

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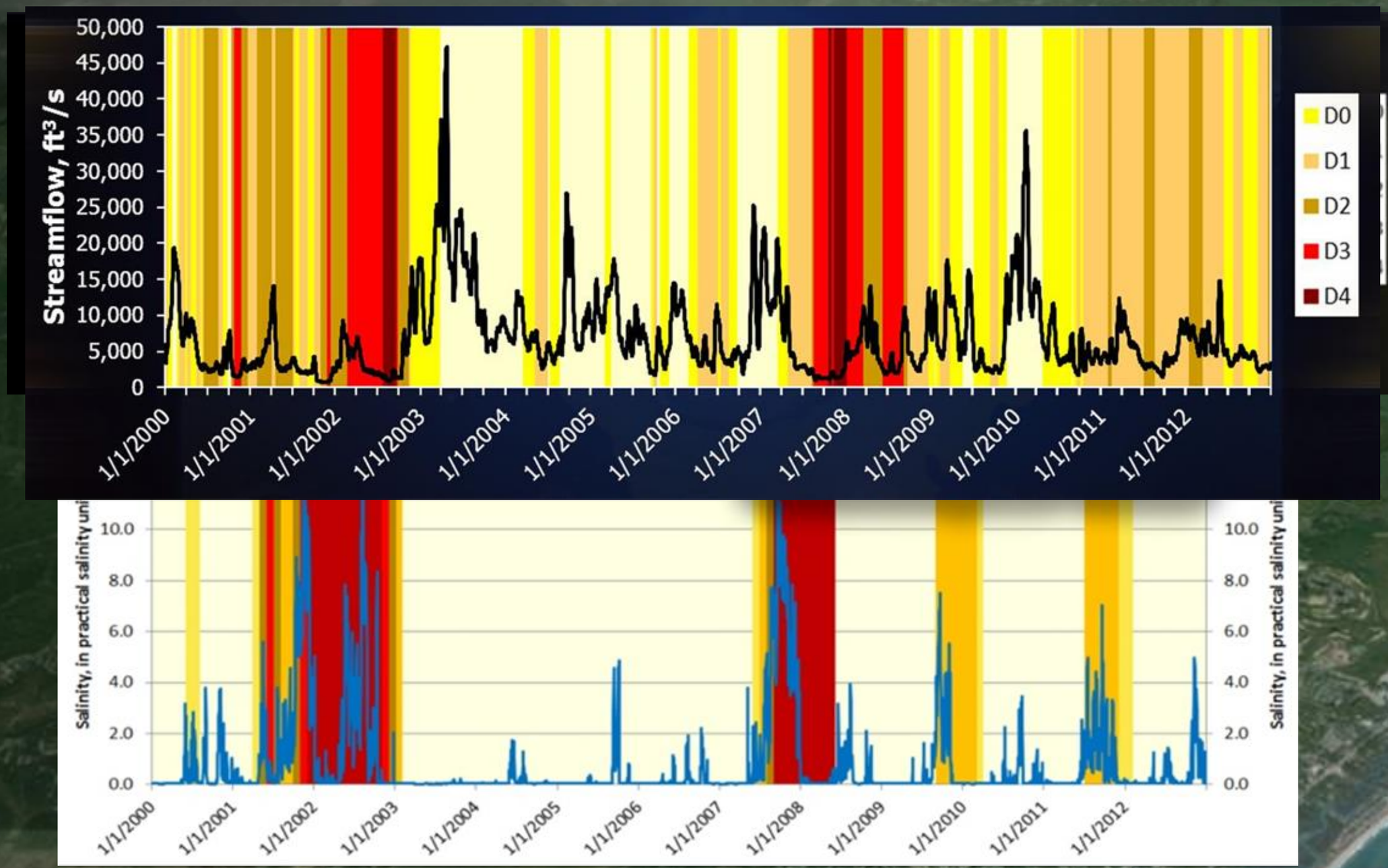
NIDIS

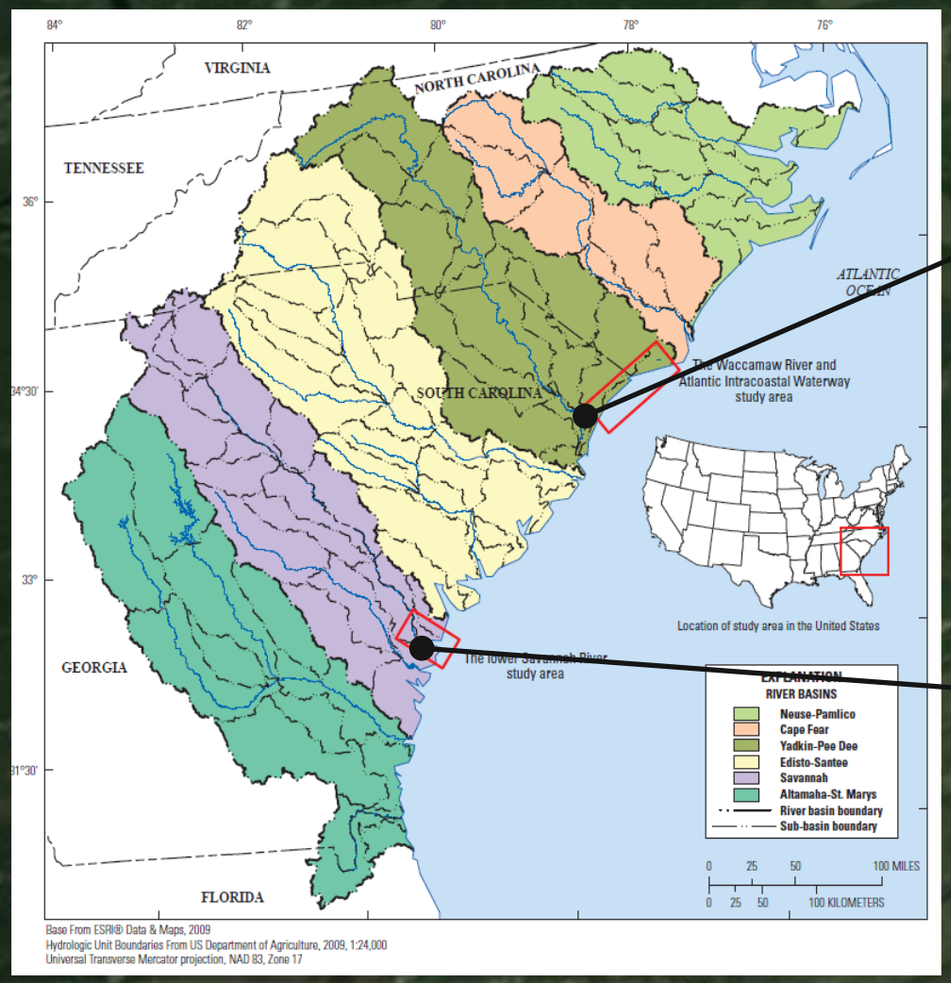
USGS

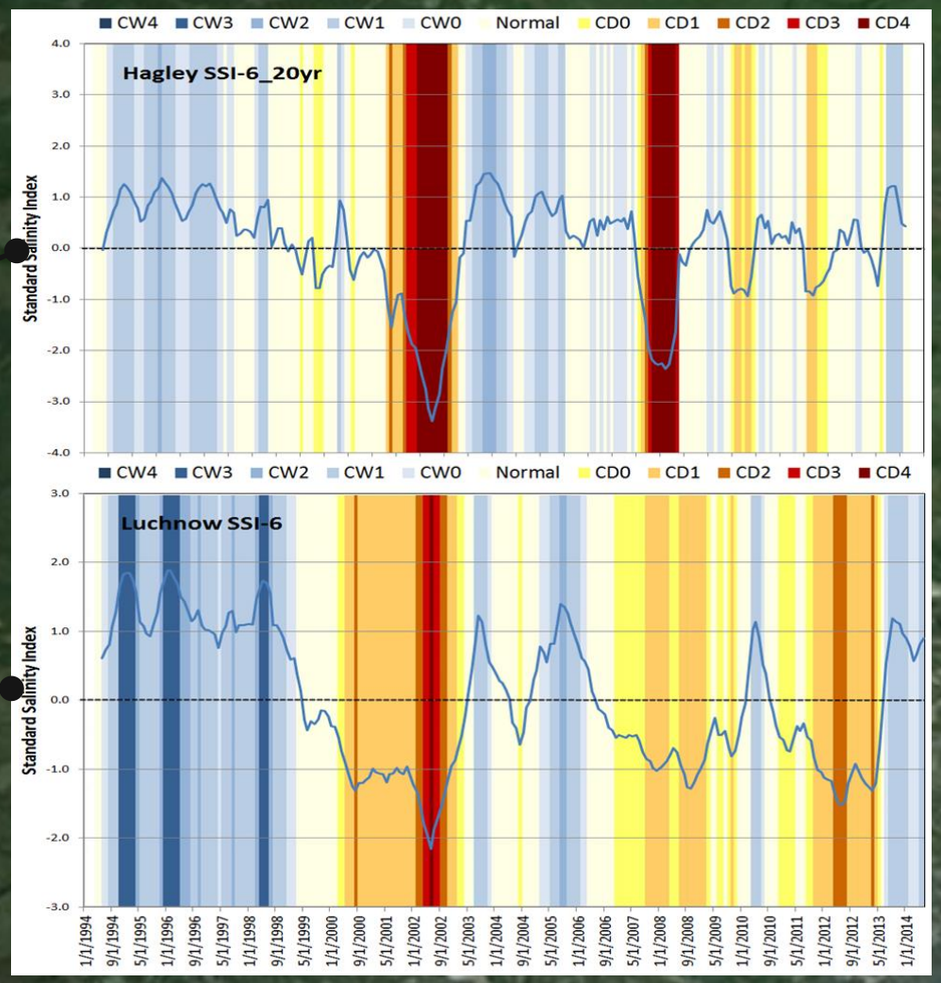
# Flow, Salinity, and DM Declarations



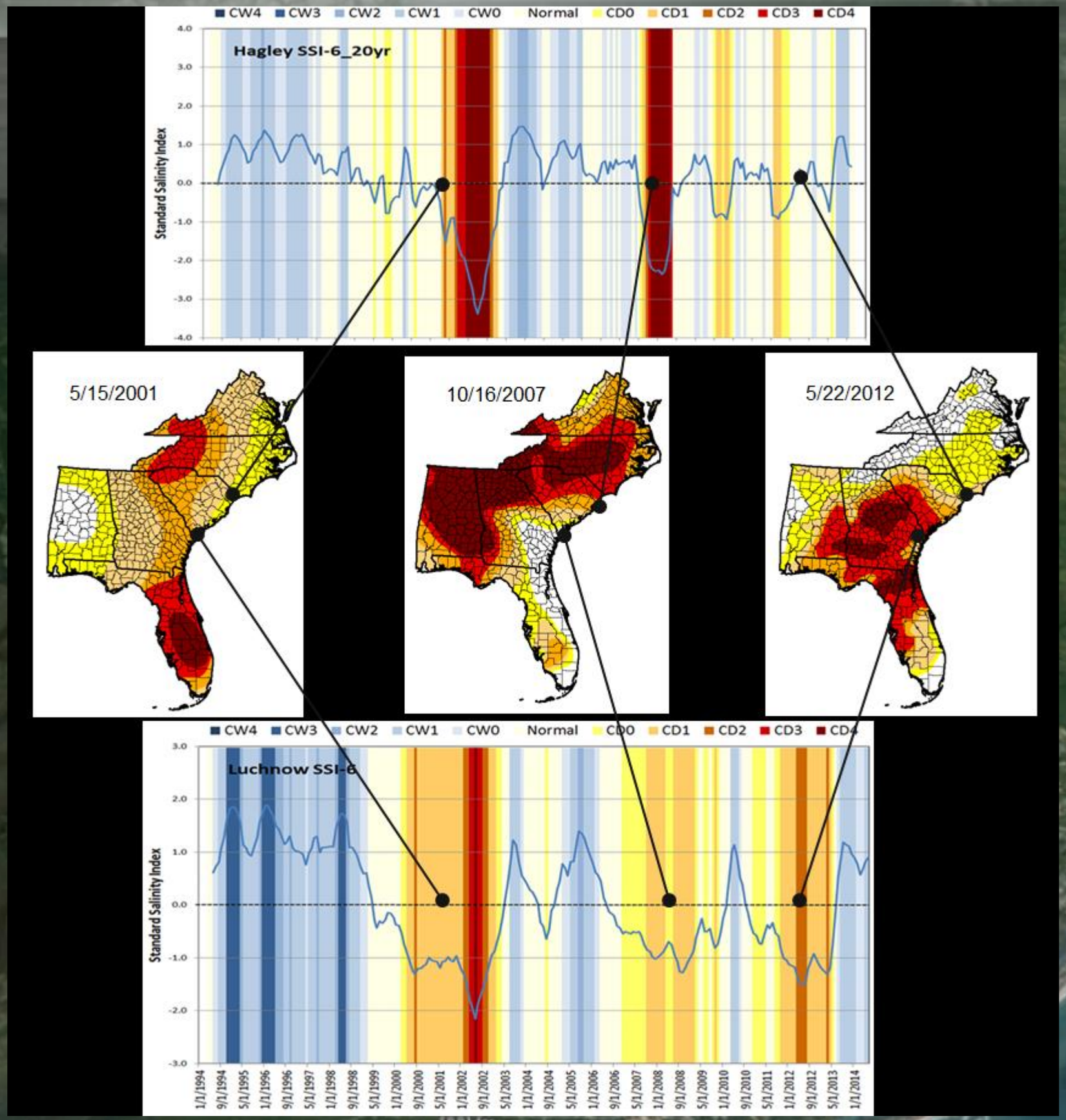
# Regional Comparison

*Is the CDI a site specific index or can it be used to regional comparisons?*



# Comparison with Drought Monitor Maps



# Coastal Drought Index (CDI)

- Next Steps
  - Publish
  - Application to other sites
  - Develop software package for consistent computation of CDI
  - Evaluate statistical aspect of the CDI
  - Analyze CDI with respect to coastal drought response variables
  - Make CDI operational on real-time basis

# Take Aways

- Broad group of Cooperators – from Power Companies to NGOs
- Common interest/need for salinity information
- Tools targeted for stakeholders
  - Excel-based Decision Support System
  - CDI – also a “freshness” index